39. $f(x) = \begin{cases} 3-x, & x<1 \quad \text{left} \\ ax^2+bx, & x \geq 1 \quad \text{right} \end{cases}$

a) continuous

$\lim_{x\to 1^-} 3-x = 2$

$\lim_{x\to 1^+} ax^2+bx = a+b$

$\boxed{a+b=2}$

b) differentiable

left -1

right $2ax+b \,\big|_{x=1} = 2a+b$

$\boxed{2a+b=-1}$

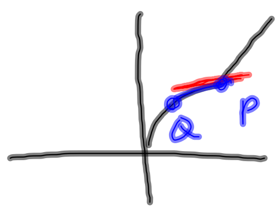
$$\begin{array}{r} a+b=2 \\ 2a+b=-1 \\ \hline -a=3 \end{array} \qquad \begin{array}{l} a=-3 \\ b=5 \end{array}$$

Sep 14-9:21 AM

23 $y = x^{2/3}$ $x = 0$

numerical der.

3 $y = \begin{cases} \sqrt{x}, & x<1 \\ 2x-1, & x \geq 1 \end{cases}$



left

$x_1 = 1$

$y_1 = 1$

$x_2 = b$

$y_2 = \sqrt{b}$

$$\lim_{b\to 1} \frac{(\sqrt{b}-1)(\sqrt{b}+1)}{(b-1)(\sqrt{b}+1)}$$

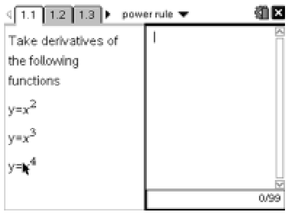
$$\lim_{b\to 1} \frac{\cancel{b-1}}{\cancel{(b-1)}(\sqrt{b}+1)} = \frac{1}{2}$$

Sep 14-9:35 AM

3.3a Rules for Differentiation

Use Power Rule.tns to discover the power rule for derivatives

$$\boxed{\frac{d}{dx}x^n = nx^{n-1}}$$



$$\frac{d}{dx}x^2 = 2x$$

$$\frac{d}{dx}x^3 = 3x^2$$

$$\frac{d}{dx}x^5 = 5x^4$$

Sep 11-9:07 PM

$$\frac{d}{dx}ax^n = a \cdot n x^{n-1}$$

Sep 14-10:03 AM

Proof of the power rule

$y = x^n$ prove $\frac{dy}{dx} = nx^{n-1}$

$x_1 = x$

$y_1 = x^n$

$x_2 = x+h$

$y_2 = (x+h)^n$

$\lim_{h\to 0} \frac{(x+h)^n - x^n}{h}$

$\lim_{h\to 0} \frac{\cancel{x^n} + nx^{n-1}\cdot h + \_\, x^{n-2}h^2 \cdots h^n - \cancel{x^n}}{h}$

$$\begin{array}{ccccccccc} & & & 1 & & 1 & & & \\ n=2 & & 1 & & 2 & & 1 & & \\ n=3 & 1 & & 3 & & 3 & & 1 & \\ 1 & & 4 & & 6 & & 4 & & 1 \quad n=4 \\ & & & & \vdots & & & & \end{array}$$

$\lim_{h\to 0} \frac{\cancel{h}(nx^{n-1} + \_\, x^{n-2}h \ldots)}{\cancel{h}}$

nx^{n-1}

Sep 11-9:45 PM

Find $\frac{dy}{dx}$ if $y = x^3 + 6x^2 - \frac{5}{3}x + 16$

$\frac{dy}{dx} = 3x^2 + 12x - \frac{5}{3}$

Sep 11-9:45 PM

Find the horizontal tangents of $y = x^4 - 2x^2 + 2$

by hand

$$\frac{dy}{dx} = 4x^3 - 4x$$

we want the

slope = 0

derivative = 0

solve for x

$$4x^3 - 4x = 0$$

$$4x(x^2 - 1) = 0$$

$$4x(x+1)(x-1) = 0$$

with the calculator

$x = 0$ $\quad y = 2$

$x = 1$ $\quad y = 1$

$x = -1$ $\quad y = 1$

Sep 11-9:56 PM

higher order derivatives

$$y = 6x^3 + x^2$$

$$y' = \frac{dy}{dx} = 18x^2 + 2x$$

$$y'' = \frac{d^2y}{dx^2} = 36x + 2$$

$$y''' = \frac{d^3y}{dx^2} = 36$$

Sep 11-10:02 PM